

THE CONSTRUCTION MATERIALS INDUSTRY  
OF THE USSR  
1955-61 AND PROSPECTS FOR 1965



November 1962

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### FOREWORD

This report is concerned with recent and projected developments in the construction materials industry of the USSR. In the first section the rates of growth of the industry are compared with other segments of the Soviet economy, and several indexes of the production of construction materials also are compared. In the second section the component branches of the industry are examined, including their relative importance and the individual problems and possibilities for the development of the more important component industries.

Data for 1961 are fragmentary, and the data that have been published usually are preliminary and subject to revision. Because of these factors, preliminary data for 1961 are included in the tables wherever possible but are not often included in the discussion. For example, indexes for production of construction materials in 1961 have been calculated from preliminary data for products representing less than one-half of the total value of production of construction materials.

When final data for 1961 are available, this index will be revised for 1950, 1955-61, and 1965 with a detailed methodology of the derivation of prices and output and the subtractions necessary to obtain the value-added index.

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THE CONSTRUCTION MATERIALS INDUSTRY OF THE USSR  
1955-61 AND PROSPECTS FOR 1965

Summary

The volume of construction in the USSR has increased at such a rate that the problem of inadequate supplies of construction materials has not yet been significantly eased in spite of the continuing emphasis on expanding output. Projected rates of growth during 1961-65 suggest that the supply shortage may become even more acute. Nevertheless, a representative index of production of Soviet construction materials increased at an average annual rate of more than 12 percent during 1951-60. The corresponding rate for the US was about 3 percent.

In an attempt to facilitate the growth and at the same time to assist in lowering the costs of construction, the emphasis on a number of the important components of the construction materials industry is shifting. These intra-industry structural changes have favored the more highly fabricated materials in general in order to aid in the industrialization of construction and to help reduce its requirements for lumber and steel. The materials receiving primary emphasis are cement and precast concrete. Cement is the indispensable ingredient for precast concrete, the expanded output of which is to be substituted for structural lumber and steel, thus reducing the consumption of these two products per unit of construction. Moreover, the increased use of precast concrete components will assist in lowering construction costs by shifting more construction operations into plants, thus permitting better organization and mechanization of production processes. The output and use of large wall panels (a subcategory of precast concrete) is being expanded rapidly in order to decrease the extensive reliance on brick as a wall material.

Plans for production of precast concrete components have been overfulfilled in the past, and this trend probably will continue, but production will not be sufficient to satisfy the greatly increased requirements of the expanded construction program. The quality of precast concrete, however, will remain low (requiring excessive maintenance of structures composed of this material) because of the need to continue to scrim in the use of cement and because of the low quality of the rock products available for concrete aggregates. These shortages will result from the failure both to fulfill the goal for production of cement and to plan and produce adequate rock products of good quality. Difficulties in the large wall panel program will prevent fulfillment of its production goals, and, as a result, the primary dependence on brick for masonry wall materials will continue.

## I. Construction Materials in General

### A. Importance in the Soviet Economy

The significance of construction materials in the Soviet economy is indicated by their share of the expenditures of the construction organizations and their share of the basic inputs of industry. During 1950-60, between 53 and 56 percent of the actual expenditures on construction-installation work were for construction materials (including the cost of transportation to the construction site). By 1965 this share is planned to increase to 60 percent, 1/\* primarily because of the increased fabrication of materials in construction material plants (in the case of precast concrete) and because of the increasing mechanization of construction work on the site. As of 1 January 1960 the construction materials industry utilized 5.3 percent of the industrial productive fixed capital assets (valued at replacement costs, in 1 July 1955 prices). In addition, the industry accounted for 7.1 percent of the total number of industrial wageworkers in 1960.\*\* 2/

A comparison of the annual rate of growth of construction materials since 1950 with the rates of growth of industrial production and of the construction industry indicates that although output of construction materials has exceeded the rate of increase of the total industrial production, it has generally lagged behind the increase in the volume of construction (see Table 1\*\*\*). The rate in excess of that for industrial production is to be expected because construction materials are components of capital goods, which on the average have exceeded the rate of increase for other goods in the Soviet economy for many years because of the priorities assigned to them. Nevertheless, the volume of construction up to 1960 has so increased that the problem of inadequate supplies of construction materials has not yet been measurably eased. Future projected rates of growth of the construction and materials indexes suggest that the shortage of construction materials will become even more acute in 1965, although, if the original Seven Year Plan goals for construction and construction materials were merely

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\* For serially numbered source references, see Appendix C.

\*\* These percentages somewhat understate the resources used in production of construction materials because presumably those in the lumber, steel, and glass industries are not included. For the probable Soviet definition of construction materials, see B, p. 5, below.

\*\*\* Table 1 follows on p. 4.



Table 1

Indexes of Production of Construction Materials, Construction-Installation Work,  
and the Total Industrial Production in the USSR a/  
1950, 1955-61, and 1965

	1950 = 100								
	<u>1950</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u> <u>b/</u>	<u>1965</u> <u>c/</u>
Computed value-added index of production of construction materials <u>d/</u>	100	178	191	218	253	290	318	338	492
Value-added index of total industrial production <u>e/</u>	100	162	179	199	217	235	250	267	N.A.
Index of value of construction- installation work <u>f/</u>	100	172	195	221	258	293	332	347 <u>g/</u>	530 <u>h/</u>

a. These indexes are based on value.

b. Preliminary.

c. Estimated.

d. This index is derived from unrounded data and may not agree with an index derived from the rounded data shown in Table 5, Appendix A, p. 27, below. For an explanation of the term value added as used in this report with reference to the construction materials industry of the USSR, see the methodology, Appendix B. The figure for 1961 was derived as explained in the methodology.

e. 3/

f. Excluding private housing and collective farm construction, which, on the basis of preliminary evidence, probably would raise the index slightly. Data for 1950 and 1955-60 are based on source 4/.

g. 5/

h. On the basis of performance during 1959-60, an estimated average annual increase of 10 percent was used for 1965, and the result was rounded.

fulfilled, the index of construction would have increased to only 413 and that of materials to somewhat above 480. Even if the revised goals for construction materials were fulfilled, that index would have been revised only to somewhat above 490 and still would have been considerably below the level expected for construction in 1965.\*

#### B. Comparison of Indexes of Production

Listed below in Table 2\*\* are four indexes of production of construction materials in the USSR and one for the US. An analysis of the assumptions made for each index indicates the validity of each of the Soviet indexes and the comparability to the US index and explains the varying rates of increase among the Soviet indexes. The Soviet indexes are shown in the chart, Figure 1.\*\*\*

The old and new official Soviet indexes are based on the gross value of production of construction materials, excluding transportation. The extremely rapid rate of increase in these indexes is caused mainly by the exclusion of lumber and steel, as they are subcategories of larger industries. Flat glass also is excluded, but because it accounts for less than 2-1/2 percent of the total value of construction materials during 1950-65, it has little effect on the index. These materials combined occupy a large but declining share in the gross value of production during 1950-60. In 1950 they accounted for 64 percent of the value of all materials, but although the computed index of the gross value of all materials increased at an average annual rate of 12.8 percent from 1950 to 1960, the comparable rate for these materials was only 7.9 percent, and their share of the total decreased to 41 percent.<sup>†</sup> This situation is due to the relative maturity of the lumber industry even in 1950 and the trend toward the substitution of precast concrete<sup>††</sup> for both lumber and structural steel during the period, so that the

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\* The planned increase in construction is derived from a planned 60-percent increase in 1965 above the level of 1958 (in centralized construction). 6/ The alternative increases in the construction materials index were all calculated as in Table 5, Appendix A, p. 27, below, by making the necessary changes in the individual commodities.

\*\* Table 2 follows on p. 6.

\*\*\* Following p. 6.

† These percentages are based on the computed gross value of production derived from Table 5, Appendix A, p. 27, below, unless otherwise indicated. When lumber, steel, and flat glass are omitted from this index, it becomes almost identical with the new official Soviet index and increases as follows: 1955, 227; 1956, 264; 1957, 324; 1958, 394; 1959, 466; and 1960, 541.

†† This category includes only concrete cast at some place removed from where it is to be used, as opposed to monolithic concrete, which is cast in place.

Table 2

Indexes of Production of Construction Materials  
and Average Annual Rates of Increase in the USSR and the US a/  
1950, 1955-61, and 1965

	Index (1950 = 100)									Average Annual Rates of Increase (Percent)	
	1950	1955	1956	1957	1958	1959	1960	1961 <u>b/</u>	1965	1951-60	1961-65
Official Soviet index of the gross value of production of construction materials <u>c/</u>											
Old index	100 <u>d/</u>	229 <u>d/</u>	254 <u>e/</u>	310 <u>e/</u>	375 <u>e/</u>	460 <u>e/</u>	543 <u>f/</u>	N.A.	940 (Plan) <u>g/</u>	18.4	11.6
New index	100 <u>h/</u>	235 <u>h/</u>	261 <u>i/</u>	324 <u>i/</u>	392 <u>h/</u>	469 <u>h/</u>	550 <u>h/</u>	616 <u>j/</u>	980 <u>i/</u>	18.6	12.2
Computed index of the gross value of production of construction materials in the USSR <u>k/</u>	100	180	195	224	261	301	332	357	520	12.8	9.4
Computed value-added index of production of construction materials in the USSR <u>k/</u> <u>l/</u>	100	178	191	218	253	290	318	338	492	12.3	9.1
Value-added index of production of construction materials in the US <u>m/</u>	100	118	121	121	115	129	129	128	N.A.	2.6	N.A.

a. These indexes are based on value.

b. Preliminary.

c. Excluding lumber, steel, and flat glass. The old index is based on pre-1960 data. The new index is based on changes in the classification of industries and probably includes some of the new and faster growing although minor industries.

d. 7/e. 8/f. Gross output in 1960 increased by 18 percent above the level of 1959. 9/g. The level of 1965 is to be more than 2.5 times the level of 1958. The minimum (2.5 times) was assumed. 10/h. 11/

i. Data for 1956 were computed on the basis of the same percent of increase for 1956 over 1955 as in the old series. Data for 1957 were computed on the basis of the same percent of increase for 1958 over 1957 as in the old series. Data for 1965 are estimated on the basis of the same increase as in the old index.

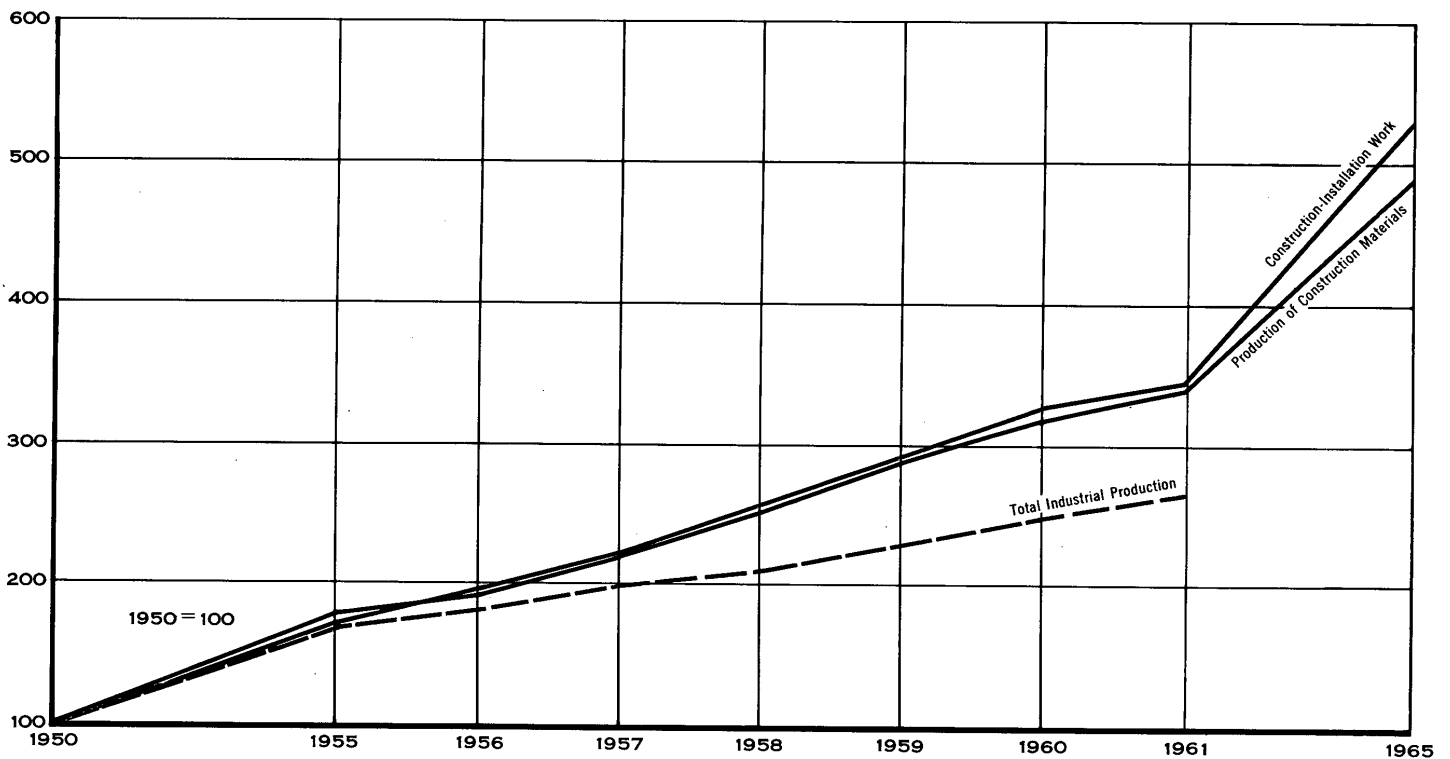
j. Gross output in 1961 increased by 12 percent above the level of 1960. 12/

k. These indexes are derived from unrounded data and may not agree with indexes derived from the rounded data shown in Table 5, Appendix A, p. 27, below. Derivation is explained in the methodology, Appendix B.

l. For an explanation of the term value added as used in this report with reference to the construction materials industry of the USSR, see the methodology, Appendix B.m. 13/

Figure 1

**USSR: Indexes of Comparative Growth in Production of Construction Materials, Construction-Installation Work, and the Total Industrial Production, 1950, 1955-61, and 1965**



inclusion of precast concrete in all indexes requires the inclusion of lumber and steel to obtain a realistic index of the increases in construction materials.

The computed value-added index of production of construction materials is a more valid index for the USSR than either of the gross indexes. This index includes all of the materials in the computed gross index but excludes the inherent duplication of the computed gross index. A comparison of the rates of increase reveals that the computed gross index increases only slightly faster than the value-added index in the USSR. This situation occurs because most of the commodities are bulky, and consequently the extractive and processing stages are usually combined and are performed by the same enterprise, so that the multiple accounting for a commodity that results from further processing by other enterprises is minimized. The rate differential that does occur is caused primarily by the rapidly increasing production of precast concrete, which does introduce more double accounting into the index.

The value-added indexes for the USSR and the US given in Table 2\* are close enough in concept and coverage to allow meaningful comparisons to be made, but with some reservations.\*\* Although transportation of the finished products is generally excluded from both indexes, there are some Soviet products which are priced including transportation and for which there was no valid indication of what part of the price reflected this element. In 1960 the total value of these products was 7.6 percent of the total gross value, but because generally these were not high-bulk, low-value products, transportation was a relatively small share of their value. Similarly, the US index is dependent not only on production statistics but also on shipments and sales statistics for a number of commodities, and this fact introduces a slight distortion in the index as a result of changes in inventories.

There are two factors that slightly lower the US average annual rate of increase compared with that for the USSR, as indicated in Table 2. Because of the cyclical conditions in the US, an average annual rate of increase based on a period from 1948 to 1960 is a better period to minimize this cyclical factor and yields a rate of 3.0 percent. The second factor cannot be quantified but is of sufficient importance to be noted. The value-added index for the USSR is estimated to include a representative sample that covers more than 90 percent of the total value of construction materials. The US index, however, does not include several important construction materials, such as aluminum products, plastics, and synthetic floor covering, which have been increasing at a much more rapid

\* P. 6, above.

\*\* For a more detailed comparison of these value-added indexes, another US index, and a materials input index of Soviet construction, see the methodology, Appendix B.

rate than the total of the other materials, and this omission introduces a slight downward bias into the index. Although aluminum products and plastics used in construction also are excluded in the Soviet value-added index, their exclusion has little effect on the index because of the relative insignificance of these commodities in the Soviet economy.

## II. Components of the Construction Materials Industry

### A. Relative Importance and Increases in Production of the Component Industries

The relative gross value of production of the various construction materials is a good measure of the comparative importance of each material to the construction industry.\* A significant shortage in the supply of any material, however, can make its output particularly critical and can increase its importance to the economy beyond that measured by its comparative gross value (for example, cement).

The relative importance and average annual rates of increase, based on gross value, are given in Table 3\*\* for 18 basically different subcategories of materials (also see the chart, Figure 2.\*\*\*). Six of these materials account for 84 to 87 percent of the gross value and are classified as the major materials. With the exception of precast concrete in 1955, the industry producing each of these materials is a mature industry with a relatively high level of output, so that the differing rates of increase are a good measure of the relative priority of each industry when compared with the average rate for the major materials. The first two of these materials increase at rates above the average for the group during both periods and account for increasing shares of the total output in both 1960 and 1965. The rapid rate of increase in cement and precast concrete reflects the increasing emphasis on the use of concrete in construction. The rapid increase in the value of wall materials during 1961-65 is primarily due to the shift in emphasis from the less expensive brick to large wall blocks because, in terms of physical units, wall materials will increase at an average annual rate of 8.2 percent during 1961-65.

The other major materials, with the exception of rock products and steel in 1961-65, increase at below-average rates for the group of major materials in both periods. Although output of rock products in

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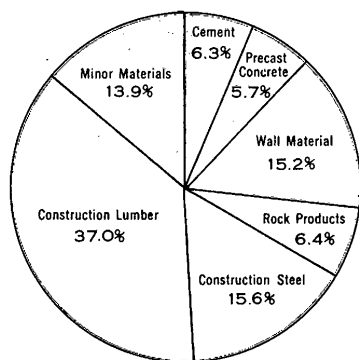
\* Cement is the only material for which increases in quality are reflected in the value figures in the various years. The average quality of cement has a measurable economic effect in construction. See B, p. 11, below.

\*\* Table 3 follows on p. 9.

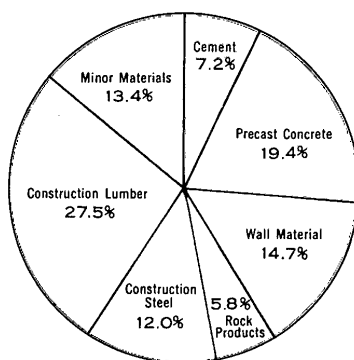
\*\*\* Following p. 8.

Figure 2

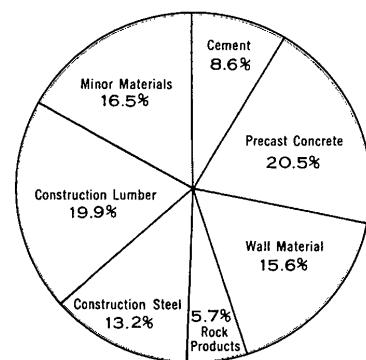
**USSR: Share of Major and Minor Materials in the Gross Value of Production of Construction Materials, 1955, 1960, and 1965**



**1955**



**1960**



**1965**

*Note: Figures may not add to 100 percent because of rounding of the original data.*

Table 3

Relative Gross Value and Average Annual Rates of Increase in Production  
of Construction Materials in the USSR a/  
1955, 1960, and 1965

	Percent				
	Relative Gross Value			Average Annual Rates of Increase	
	1955	1960	1965	1956-60	1961-65
Major materials	86.1	86.6	83.5	13.2	8.6
Cement	6.3	7.2	8.6	16.2	13.2
Precast concrete (including prestressed)	5.7	19.4	20.5	44.6	10.6
Wall materials	15.2	14.7	15.6	12.3	10.7
Rock products	6.4	5.8	5.7	11.0	8.7
Construction steel	15.6	12.0	13.2	7.2	11.5
Construction lumber	37.0	27.5	19.9	6.6	2.5
Minor materials	13.9	13.4	16.5	12.2	14.1
Linoleum	0.3	0.4	0.9	16.7	30.9
Flat glass (window and polished)	1.9	1.7	1.7	10.1	10.6
Construction lime	1.3	1.1	1.2	9.0	10.9
Gypsum and gypsum board	1.0	1.1	1.2	14.5	12.0
Tile (flooring, facing, and roofing)	1.1	1.1	1.4	14.1	13.6
Soft roofing	1.3	1.0	1.2	8.3	11.8
Asbestos cement products	1.8	1.9	2.4	13.9	15.2
Iron and ceramic sewer pipe	0.8	0.8	0.8	12.2	11.0
Sanitary technical equipment	1.5	1.7	1.9	16.4	11.4
Mineral wool insulation	0.3	0.3	0.6	20.1	21.5
Wood fiber slabs	0.2	0.5	1.5	32.6	34.7
Refractories	2.4	1.8	1.7	6.6	7.8
Total	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>		
Average annual rate of increase					
Gross value				13.0	9.4
Value added				12.3	9.1

a. The categories of materials have been condensed from Table 5, Appendix A, p. 27, below, and the percentages in this table have been derived from the value data in Table 5. Totals and average annual rates are derived independently from unrounded data and may not agree with the rounded data shown.



the later period increases at about the same average annual rate as that for the group, their share as an input into other construction materials must increase from 21 percent in 1960 to 25 percent in 1965. This factor suggests that, rather than being mitigated, the shortages which existed during 1960 will become more serious in the future. The rate of increase for steel in the first period is depressed by an absolute decrease in the use of rails in 1960 compared with 1955 (from 31 to 20 percent of the total), and the high rate in 1961-65 is made possible by a rapid increase in the use of steel pipe in construction from 17 percent of the total in 1960 to 27 percent in 1965. The very low rate of increase in production of lumber is due to the substitution of concrete for lumber in construction and to the decreasing emphasis on cast-in-place concrete, which entails a greater use of wood for forms and scaffolding.

Among the minor industries, particularly high rates of increase are evident for linoleum, mineral wool insulation, and wood fiber slabs. All three of these were infant industries in both 1955 and 1960, so that their bases were low, but the expansion of their output also has been receiving considerable emphasis because of their need in the housing program and the possible savings in their use as substitutes for other materials.

Two of the major categories in Table 3,\* construction steel and lumber, are unique in that they are subcategories of considerably larger industries. In the USSR in 1955 and 1958 the total tonnage of steel used in construction was 28 and 26 percent as large, respectively, as the total apparent consumption of rolled steel in each of those years, and, excluding rails and pipe from construction steel, the tonnage used was 17 and 16 percent as large, respectively, as all rolled steel.\*\* In the US in the same years, construction steel was 16 and 20 percent as great, respectively, as the apparent consumption of rolled steel, and, excluding rails and pipe from construction steel, the comparable figures are 11 and 15 percent.\*\*\* Thus a

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\* P. 9, above.

\*\* Production plus imports minus exports equals apparent consumption. The total quantities of construction steel are presumed to be in finished forms, so that the loss in weight in converting from rolled steel to the forms used in construction is not accounted for in these figures. On the basis of US experience, about 30 percent of all rolled steel in the USSR in 1955 and 1958 was allocated to construction.

\*\*\* In the US in 1955, 18 percent of the apparent consumption of rolled steel was converted into the various forms for the use of the construction industry, and in 1958 21 percent was converted. US percentages in the text have a slight upward bias because the loss incurred in manufacturing pipe is excluded from the figures for total US rolled steel but not from the Soviet figures. However, [footnote continued on p. 11]

greater share of total rolled steel is used in construction in the USSR than in the US, but by excluding pipe and rail from construction steel the difference is lessened.

A greater share of the apparent physical consumption of industrial wood (all logs except firewood) is used in construction in the USSR than in the US. In 1958, 59 percent of the apparent consumption of industrial wood was used for lumber and ties in the USSR and 51 percent in the US.\*

## B. Component Industries\*\*

### 1. Cement

Production of cement in the USSR has been increasing at a rapid rate, but it has not kept pace with demand in the past, and this trend will continue. During 1956-60 the volume of physical production of cement increased at an average annual rate of 15.2 percent, and annual production was usually relatively close to planned levels.\*\*\* Also during this period, production of cement per million rubles of construction-installation work (hereafter called a construction unit) increased from 225 tons in 1955 to 236 tons in 1960, so that the consumption of cement per construction unit was increasing.† According

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the figures for total rolled steel are not identical categories in both countries, because the US figure excludes cold rolled steel. If, to avoid this problem, a figure for the total shipments of rolled steel is substituted in the US, all percentages are increased from 1 to 2 percent.

\* Lumber and ties are converted to logs by dividing by a factor of 0.67. For an explanation of the rationale of equating the use of lumber and ties with the use of wood products in construction, see Appendix B.

\*\* Unless otherwise indicated, annual production figures and average annual rates of increase in this section are taken from Table 5, Appendix A, p. 27, below. The value of construction-installation work was obtained from the sources given in Table 1, p. 4, above.

\*\*\* Under the Sixth Five Year Plan the 1960 goal was 55 million metric tons. (Tonnages are given in metric tons throughout this report.) This figure was later lowered to 52 million tons. The final plan for 1960 was 45.5 million tons, and this goal was fulfilled. 14/

† In this discussion, production and consumption are used interchangeably because net imports were of relatively small magnitude during 1955-60, reaching a peak of 6.4 percent of the total apparent consumption in 1956 and decreasing in each year since, so that in 1960 they were only 2.8 percent. With the rapid increases in production and the probably stable level of net [footnote continued on p. 12]

to the original goals for 1965, production of cement was to increase to 75 million to 81 million tons, thereby making from about 310 to 340 tons of cement available per construction unit. During 1959 and 1960, however, increases in the volume of construction-installation work indicated that the plan for 1965 will be substantially exceeded, so that only about 240 to 260 tons of cement would have been available per construction unit in 1965. To compensate for the expanded need, the production goal for cement in 1965 was increased to 84.6 million tons. 15/ However, this increase will allow only about 270 tons per construction unit in that year, and, with the estimated production of 81 million tons in 1965, only about 260 tons per construction unit will be available. This gap probably cannot be made up by imports, and, as a result, a shortage of cement will remain a major hindrance to the construction effort.

The prime cause of the difficulty in expanding production in the past has been the lagging expansion of capacity in the cement industry.\* This shortfall is caused by a failure to concentrate investment on the most important projects, an underestimation of the investment required (that is, costs are greater than planned), and the fact that completions of projects have taken longer than specified in the norms. A major contributing factor to the slowness in completing projects has been the shortage of cement plant equipment. In the past the USSR has been dependent on imports from East Germany for most of its equipment. During 1950-55, complete equipment for production of 10 million tons of cement, or 23 plants, was imported from East Germany. These imports have continued, although the USSR is now attempting to become almost self-sufficient in the manufacture of this equipment. At 4 major machine building plants, 29 production lines (kilns and ancillary equipment) were scheduled for completion in 1958-59, but not one complete line had been delivered by September 1960, and, in mid-October 1961, not one line had been completely delivered of the 12 scheduled for that year. 16/ Poor advance planning contributes to the equipment shortage also, as frequently insufficient time is allowed for delivery, and equipment is sometimes scheduled to arrive after the planned completion date for the plant.

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imports (primarily from Communist China and Rumania), there will be even less relative difference between production and apparent consumption in the future.

\* Assessment of past performance in the expansion of capacity of the cement industry is difficult because of the frequent revision of investment plans and the often conflicting statements on plan fulfillment and increased capacity made by otherwise reliable sources. Future and even present plans for adding new capacity often reveal significant areas of indecision or undue flexibility in the planning apparatus.

During 1956-60 the total of annual plans for additions of new capacity was fulfilled by only 55 to 65 percent, and yet annual production plans were generally fulfilled. Since 1958, however, particular emphasis has been placed on fulfilling annual plans for additions to capacity. In 1961, for example, 27 projects (which accounted for 76 percent of all cement capacity to be commissioned) were included in a list of 434 top-priority projects. 17/ As a result, actual annual additions have more closely approached planned levels. For example, in 1960 the plan was fulfilled by 78 percent, and in 1961 a 71-percent fulfillment was achieved. 18/ To fulfill the production goal for 1965, however, the fulfillment of annual goals\* for adding capacity must be further improved, as the possibility of gains by intensifying production at existing plants is considerably diminished. Unless the priorities for adding new capacity in the cement industry are increased significantly, the production goal for cement in 1965 will not be fulfilled.

Another problem facing the Soviet cement industry is the regional disparities between production and consumption. These disparities do not appear to be easing significantly, because expansion of existing plants has been the primary means of increasing production. The proportional trends in the various means of increasing production are given in Table 4.

Table 4

Means of Increasing Production in the Cement Industry in the USSR  
Selected Periods, 1951-65

Time Period	Percent		
	Intensification of Production and Modernization of Equipment at Existing Plants	Expansion of Existing Plants	New Plants
1951-55 <u>a/</u>		38	62
1952-58 <u>b/</u>	25	27	48
1959-65 (Plan) <u>c/</u>	11	52	37
a. <u>20/</u>	b. <u>21/</u>	c. <u>22/</u>	

\* The total planned addition to capacity for 1961-65 is to be 49.4 million tons at 26 new plants and 45 expanded or reconstructed existing plants utilizing 109 new production lines. 19/

The relative decrease in reliance on modernization results from the realization by the planners that this means of increasing production has become quite limited. Early indications in the 1959-65 Plan were that new plant construction would be expanded, a move that would tend to improve the distribution in the regional production of cement because new plants are usually constructed in areas that are particularly deficient in the supply of cement. The actual plan, however, sharply reduced the reliance on new plants and increased the emphasis on the expansion of existing plants. These changes are prompted by an acute need for increased production of cement and by the high cost of new plants compared with the other means of increasing productive capacity as well as the difficulties in getting new plants into operation according to plan. Capital expenditures, per unit of capacity, for building new plants average 33 percent higher than the expenditures required to expand existing plants,\* and whereas the minimum time required to build a new plant has been from 2-1/2 to 3 years, existing plants frequently can be expanded in 1 year.

The greater difficulty in constructing new plants is reflected in the number of new plants planned and completed during 1956-60. Twenty-seven new plants were originally scheduled to be commissioned, but this figure was decreased to 16 when the production plan was revised downward. Actual commissionings are now estimated to have been nine or ten plants, with the majority of the plants commissioned considerably later than scheduled during the period. In addition, new plant construction was particularly deficient in the Eastern Regions of the USSR. This situation has caused a continuation of the regional shortage of cement and an inordinately long average length of haul, which has actually increased from 550 kilometers (km) in 1955 to 595 km in 1958, so that the plan to reduce the average length of haul to 325 km in 1965 23/ probably will not be met.

A further problem in the transportation, loading, and unloading of cement has been the heavy losses of cement (stated to be as high as 15 percent) suffered during these operations. 24/ The solution to this problem requires more and better loading and unloading equipment; storage facilities; and the widespread use of special railroad cars and trucks for hauling cement, as in the US. It is very unlikely that significant improvements will be made in these areas by 1965.

It is possible that by 1963 the USSR will surpass the US in the annual quantity of cement produced. In 1962 the USSR plans to produce 57.1 million tons, and this plan probably will be fulfilled. Production in the US for 1962 is estimated at about 59 million tons (including portland, masonry, and other hydraulic cements). In the USSR the

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\* See Table 6, Appendix A, p. 29, below.

annual production has increased by an average of almost 6 million tons per year since 1958, while in the US the estimate for 1962 is only about 4 million tons above the level of 1958. However, although the quality or average grade\* of cement in the USSR has been increasing, it will be considerably below that of the US even in 1965. The quality of cement is very important because the quantity of cement required to make concrete of a given strength varies with the quality used. Thus the higher average quality cement in the US is equivalent to a greater quantity of Soviet cement -- for example, in the USSR an average grade of 460 was originally planned for 1965 (and probably will be achieved), while the average grade in the US is about 550. <sup>25</sup>/ The US grade is equivalent to 12.5 percent more cement than the Soviet grade, so that in 1965, although the USSR will produce about 81 million tons, it will be equivalent to about 72 million tons of US cement.

## 2. Precast Concrete

Since 1954, considerable emphasis has been given to the precast concrete program in the USSR. Premier Khrushchev has indicated his interest in this program as one of the principal means of fulfilling industrialization plans and attaining a high rate of growth in the construction industry. The economic rationale for this program is as follows:

a. The use of precast concrete as a substitute for lumber and steel permits a decrease in the use of such materials per construction unit. Shortages of these materials have been a hindrance to the construction effort for a number of years.

b. A reduction in the requirements for on-site labor per construction unit and an increase in the efficiency of the construction labor force are attained. There is a considerable reduction in the need for skilled labor, such as bricklayers, structural steel workers, and carpenters for form work. Semiskilled and unskilled labor can be more efficiently utilized by transferring such persons to more mechanized and regularized fabrication processes in precast concrete plants.

c. A reduction of construction costs during the long and severe winters that are characteristic of most parts of the USSR is accomplished by performing more construction tasks in plants -- for example, concrete pouring and brick laying on-site during below-freezing

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\* The grade number, or mark, of cement in the USSR indicates the 28-day compressive strength (measured in kilograms per square centimeter) of a cube made up of one part of cement to three parts of sand and a water-cement ratio of 1 to 0.5.

temperature requires temporary enclosure and heating of the work area, a procedure that is relatively expensive.\*

d. The transfer of functions to plants permits the relocation of the limited supplies of equipment into plants, where the equipment -- such as concrete mixers and batch plants -- can be more efficiently utilized.

In terms of planned levels of production since 1955, the precast concrete program has exceeded expectations, and this situation will continue, although plans frequently have been revised upward. The 1960 plan, for example, was increased from 28 million cubic meters (cu m) under the Sixth Five Year Plan directives, to 28.8 million cu m, and production was 32.3 million cu m. For 1965 the goal has been increased from a range of between 42 million and 45 million cu m to 47.2 million cu m, and production should exceed this revised goal and reach at least 52 million cu m. 26/ By 1965, precast concrete will be the most important construction material (in terms of value) and will account for about one-fifth of the total value of construction materials in that year.

The rapid increase in production of precast concrete has permitted a considerable increase in its consumption per construction unit because production and consumption in any given period are roughly the same. In 1955, 53 cu m were used per construction unit; in 1960, 167 cu m were used; and under the old construction plans the amount was scheduled to increase to between 175 and 188 cu m per construction unit. This trend not only reflects the substitution of precast concrete for lumber, steel, and other masonry wall materials but also reflects its use in place of monolithic (poured-in-place) concrete. In 1955, for example, precast concrete accounted for 15.6 percent of the total concrete; in 1957 it had increased to 26.5 percent; and under the original Seven Year Plan goals it was to have increased to more than 35 percent in 1965. 27/

Because the construction goal for 1965 will be significantly exceeded, the plan for production of precast concrete was increased, but not enough to compensate for the increase in construction. Even with the estimated exceeding of the goal for production of precast concrete in 1965, the use per construction unit will remain about the same as in 1960. Numerous statements by Soviet officials that the use

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\* In the USSR, chemicals such as calcium chloride are used to permit placement of concrete in cold weather without heating, but this practice has a deleterious effect on steel reinforcement and the strength of the concrete and is not sufficient in extremely cold weather.

per construction unit will continue to increase indicate either that production of precast concrete will have to increase at a greater rate than presently expected or that the further industrialization of construction will be handicapped.

Several problems continue to plague the precast concrete program in spite of the rapid rate of increase in production during the past. A continuing shortage of reinforcing steel, of rock products of good quality, and particularly of cement has had serious ramifications. Attempts to use less than the optimum amount of cement in order to make it go further have caused a significant deterioration in the quality and strength of concrete. This deterioration has been compounded by the generally poor quality of rock products available for aggregates, a situation that has required the use of more cement than would be necessary with aggregates of good quality. Also, optimum use is not made of the available reinforcing steel, which is sometimes carelessly placed, so that the maximum benefits are not obtained from the available steel. The result of these shortages, together with the extremely rapid expansion of production of precast concrete, has been a poor quality of concrete products, resulting in relatively high maintenance costs of structures composed of concrete. A further problem that faces the industry has been caused by the overmechanization of precast concrete plants, resulting in extremely high maintenance costs in the plants.

There are two important subcategories in the precast concrete program that have presented problems -- prestressed concrete\* and large wall panels. Prestressed concrete has been emphasized as long as precast concrete, but goals for prestressed concrete have been lowered and are still badly underfulfilled. In 1958, only 75 percent fulfillment was achieved and in 1959 81 percent. In 1960, only 58 percent of the original goal for that year was achieved. Production of prestressed concrete has a particular importance in the USSR because it permits savings of as much as 50 percent in the weight of steel and 10 percent in concrete. 28/ More expensive special types of steel, however, should be used that can withstand and hold the stress. This program has suffered because of the greater investment required, the acute shortage of the special steels required, and the technical difficulty in producing prestressed concrete. In the last several years, plan fulfillment has increased somewhat, partially because of lowered

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\* In making prestressed concrete the reinforcing steel is put under tension -- that is, one end of the steel is anchored and then the steel is stretched -- before pouring concrete into the mold. The tension is released when the concrete has hardened sufficiently, and thus a compressive force is exerted on the concrete that increases its strength.



goals but also because of the use of electrothermal prestressing.\* It is doubtful if the added costs of electrothermal prestressing (compared with regular reinforced concrete) are economically justified by the increased strength of the final product, but, using this system, the present goal for 1965 for production of prestressed concrete of 11 million cu m will probably be fulfilled.

Production in the large wall panel program commenced in 1958, but in 1959 only 355,000 cu m were produced, which was only a 41-percent plan fulfillment. In 1960, 952,000 cu m were produced. By 1965, 500 enterprises are to be constructed for production of large wall panels. Of the 122 plants scheduled for completion in 1959-60, however, only 20 were constructed by the middle of 1960. 30/ Two of the major deterrents to the success of this program have been the shortage of equipment and the slow development of production of the light fillers (aggregates) necessary for this program. Although significant increases will be made, production in 1965 probably will fall short of expectations, and the USSR will continue to rely primarily on the traditional masonry wall materials.

Any over-all evaluation of the precast concrete program in the USSR must take into consideration the unique circumstances and goals in that country. Given the limitation on available construction materials in the USSR (particularly the shortage of steel and of lumber), a dictatorial form of government which permits standardization, and the goals of the construction industry (rapid expansion, particularly of the housing program), the precast concrete program is economically justified. Because of the haste with which the precast concrete program is being expanded, however, the advantages of the program are not being maximized. This haste is reflected in the poor quality of the product and in the failure to take precautions that, by yielding a considerably better product (as well as less waste of materials), would in turn lower the need for the extensive maintenance on precast concrete buildings which is inevitable under the present circumstances.

### 3. Wall Materials

This category is defined as all masonry construction materials used for walls except reinforced concrete. The largest subcategory is brick (both clay, or baked, and silicate, or sand-lime, which is unbaked). The other subcategories are natural stone, both field

\* In electrothermal prestressing the steel is electrically preheated (causing expansion) and then is anchored by the ends in the concrete mold. Cooling self-stresses the steel. In 1959 this method accounted for 94 percent of all prestressing in Moscow (which produced about 30 percent of the prestressed concrete in the USSR). 29/

and dimension (cut); large wall blocks; and other types of wall materials (mainly small wall blocks). Large and small wall blocks are composed of cinders, slag, or sand, with cement or lime used as a binder.

It is difficult to evaluate plan fulfillment for wall materials because of the paucity of plans released and the general lack of reliable figures. These problems stem largely from the extensive number of widely scattered plants, frequently of limited size. For example, at the end of 1959 there were more than 6,500 brick plants in the USSR.\* This situation results from the widely available raw materials and the low value compared with the bulk of the products, making extensive transportation highly uneconomic. These conditions make centralized planning and statistical reporting very difficult. Long-term plans in particular have been nonexistent or highly unrealistic, as in 1960, when the plan to produce 61 billion units of wall materials was fulfilled by 73 percent. 31/

During 1961-65 the average annual rate of increase in the gross value of production of wall materials will exceed the average rate for major construction materials. In terms of physical units,\*\* however, the 8.2-percent average annual rate of increase in production during the period will be one of the lowest for any construction material, exceeding only the rate for lumber and refractories. The larger increase in the value figure reflects primarily the conversion away from the less expensive brick\*\*\* to the more costly large wall blocks. In 1960, brick accounted for 80 percent of all wall materials but will decline to 67 percent in 1965, while large wall blocks will increase from 3 percent in 1960 to 15 percent in 1965 in spite of an estimated shortfall of 35 percent in plan fulfillment. 32/

The low rate of increase in physical units will result in a decline in the use of wall materials from 256,000 and 231,000 standard brick units per construction unit in 1955 and 1960, respectively to 212,000 units in 1965, as production and consumption are roughly identical. This decline is explained by the substitution away from brick to large wall panels, which are part of the precast concrete category. The conversion from brick to large wall blocks is a move in the same direction. These changing relationships result from the

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\* See Table 7, Appendix A, p. 30, below.

\*\* The dimensions of a standard brick unit are 25 by 12 by 6.5 centimeters, and 400 of these units equal 1 cu m. This brick is considerably larger than the average US brick.

\*\*\* Soviet production of brick at present is still four to five times as great as US production, and the USSR also exceeds the US in production of most of the other masonry wall materials.

attempts to minimize the use of skilled labor (bricklayers) on the construction site and to transfer as many labor-consuming processes to plants as is feasible.\*

The share of brick in the total construction materials will not decrease to the extent planned, however, partially because brick is a traditional material, and, although costs of investment and production are high, it is still frequently the most advantageous wall material in small towns and in outlying areas. Furthermore, the ambitious plans for both large wall blocks and panels will not be fulfilled, so that primary dependence on brick will continue, and the intended extent of the decrease in on-site construction labor will not be achieved.

#### 4. Rock Products

In the USSR in 1957, 39 percent of rock products, or non-metallic minerals, are estimated to have been sand, 15 percent gravel, and 46 percent crushed stone and rubble. In the US in 1959, 21 percent was sand, 35 percent gravel, and 44 percent crushed stone. Although rock products are not used by the construction industry exclusively, other consumers utilize a relatively small percentage of the total production in the USSR. In 1957, 91.3 percent of all rock products were consumed in the construction and construction materials industries. The remainder was consumed by the metallurgical industries (7.5 percent)\*\* and the chemical industries (1.2 percent). 34/ Almost half of all rock products are utilized in production of concrete.

Output of rock products has not increased as rapidly in the past several years as have the other major construction materials (except lumber and steel), and rock products lag behind all but lumber in the average annual rate of increase of major materials during 1961-65. Considering the rapidly expanding need for rock products in precast concrete, this industry has received insufficient emphasis and is an inefficient producer of a low-quality product that is subsidized in the Soviet economy. The poor quality of the products of this industry also is responsible for compounding the cement shortage. Recent Soviet calculations indicate that the use of aggregates that do not conform to specifications causes an overexpenditure of more than 2 million tons of

\* See p. 15, above.

\*\* In 1960, Soviet blast furnaces yielded 34.2 million tons of slag, almost two-thirds of which was granulated and used as construction materials in the manufacture of portland slag cement and as concrete aggregate and road ballast. 33/

cement annually. This overexpenditure was largely caused not only by the poor quality of the aggregate but also by the frequent failure to use clean aggregates and to classify the aggregates by size, as in 1957, when more than one-half of the gravel and almost one-third of the crushed stone produced in the Soviet economy was not graded by size. 35/

The subsidization of the rock products industry is evident in the excess of prime costs\* above the selling price. In 1957 the average prime costs for production of rubble stone exceeded the average selling price by 22 percent, crushed rock by 41 percent, and gravel by 35 percent. Only the average prime cost of sand was lower than its average selling price (by 5 percent). 36/ In that year, based on these figures, prime costs exceeded the selling price by 27 percent for all rock products.

In an analysis of the importance of the rock products industry in the Soviet economy, this undervaluation of production is noteworthy. In addition, in 1958 the total expenditure on the transportation of rock products was 7.7 billion rubles\*\* or about 2.2 times the gross value of output in that year. 37/ Assuming that the 1957 cost factors were valid in 1958, these two factors added about 8.6 billion rubles to the value of rock products received by consumers, so that if this amount is added to the gross value of construction materials and of rock products, the latter becomes about 18 percent of the total rather than 5.9 percent.\*\*\*

The failure to give sufficient emphasis to this important industry has resulted in a shortage of rock products in the Soviet economy and a low level of efficiency. In 1960 the rock products industry satisfied the demand of the national economy by only 80 to 85 percent and the demand of reinforced concrete producers for crushed stone and fine gravel by only 65 to 70 percent. This shortage also is suggested by the ratio of rock products and production of cement in the USSR and the US. In 1959 the USSR produced almost two-thirds as

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\* Prime costs include all factor input costs (including amortization) but exclude profits.

\*\* Unless otherwise indicated, ruble values throughout this report are given in 1 July 1955 rubles (ruble values in use before the Soviet currency reform of 1961) and may be converted to US dollars at the rate of exchange of 6 rubles to US \$1, which reflects average relative prices of construction materials in the US and the USSR.

\*\*\* The gross value of construction materials does not include transportation costs (except for a few materials), but because, in the case of rock products, transportation is such a significant portion of the cost to the consumer, rock products would be a significantly larger percentage of the total even if the gross value included transportation costs for all materials.

much cement as the US but only one-third the quantity of rock products.\* The efficiency is reflected in the low level of mechanization of the industry in 1959, when more than 40 percent of the enterprises were classified as not even medium-mechanized enterprises and more than 40 percent of the labor force was engaged in manual operations. 38/

Although there is increasing emphasis on the rock products industry, it continues to be probably the most backward of the construction materials industries. Investment plans for the industry have been increased, and the goals for 1965, which have been given as high as about 450 million cu m, are not (even if they were attained) of sufficient quantity to satisfy consumers. In addition, the quality of production will remain low, so that this industry will continue to cause problems (particularly of quality) for the precast concrete program, which will in turn cause a continuation of the overconsumption of cement.

#### 5. Other Construction Materials

The products briefly evaluated in this section are the three groupings of older commodities (which will account jointly for 6 percent of the gross value of production of construction materials in 1965) and the newer commodities. Except for asbestos cement products, output of these older commodities is greater in the US than in the USSR, and for the newer commodities, Soviet production is only a very small fraction of output in the US.

Asbestos cement articles consist almost exclusively of flat shingles, corrugated panels, and pipe.\*\* The plants are generally either adjacent or in close proximity to cement plants because the product consists of roughly 85 percent cement to 15 percent asbestos (by weight). In 1958, about two-thirds of the roofing on houses and civil buildings in cities and workers' settlements was asbestos cement, and about one-third of the pipe in the country was asbestos cement (excluding steel pipe). 39/ The rapid increase in production by this industry in recent years will continue, and the

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\* Because of the lower average quality of cement in the USSR than in the US in terms of effectiveness, the Soviet production was equivalent to somewhat more than half of the US production (see 1, p. 11, above). In addition, road construction is a much larger share of total construction in the US than in the USSR. This type of construction requires a more intensive use of rock products than most other types.

\*\* Flat products are statistically counted in standard units (40 by 40 by 0.4 centimeters) that weigh 1.2 kilograms each, and pipe are counted in standard kilometers, 200 millimeters in diameter, and weighing approximately 19 tons per kilometer.

goals for 1965 probably will be fulfilled, permitting expanded use particularly of flat products for sidings. Asbestos cement products are relatively inexpensive and light in weight, and their expanded use is economically justified.

Production of flat glass for construction (window and polished or plate glass) has increased at a comparatively modest average annual rate in the past and will continue at about the same rate in the future. Production of window glass is sufficient for domestic needs (although of poor quality), but polished glass is in short supply, and production will increase at almost double the average annual rate for window glass during 1961-65. Nevertheless, production of polished glass in 1965 will continue to be a negligible proportion of the total construction glass -- that is, only 3.7 percent of production of window glass. In the US, polished (plate) glass is about half of the volume of window (sheet) glass.

Sanitary technical equipment is defined to include heating boilers and radiators, bathtubs, and water heaters. Their production has been increasing at a rate which is above the average for all construction materials and although this will continue during 1961-65 the average annual rate during 1961-65 will be 5 percentage points less than that of 1956-60. Production of these articles currently is inadequate for the needs of the Soviet economy and this shortage will continue. The production plans in 1960 for heating boilers and radiators were fulfilled by 85 percent, and the production plan for bathtubs was fulfilled by 93 percent. In 1965 the planned production figures are only 92, 90, and 80 percent, respectively, of the projected demand in 1965 for these items. 40/

The new materials are those which are produced in negligible quantities at present but whose production is expected to increase very rapidly during the balance of the Seven Year Plan. Most of them are substitutes for other, more expensive products. Included among these new products are the following three broad categories: plastics, waste wood products, and insulation. These materials are important because their use affords savings in costs as well as in other materials in short supply such as lumber and metals.

The most important category of plastics is synthetic floor coverings. Linoleum, which is the most important type, was planned to increase at an average annual rate of 34.5 percent during 1959-65 and in 1965 was to account for approximately one-third of all flooring (both in new construction and in maintenance). The large increase in production was based on the possible savings in cost compared with

other types of flooring. During 1959, production costs for linoleum were only 53 percent of the wholesale price of 22 rubles per square meter (sq m) and this price was to be reduced to 16 rubles per sq m, so that linoleum would cost 10 rubles per sq m less than plank flooring and 57 rubles per sq m less than parquet flooring. In 1965 the planned production and use of 100 million sq m of linoleum, therefore, was to save more than 1 billion rubles as well as 7 million cu m of lumber. Although the goal for production in 1958 was exceeded by 6.7 percent, the ambitious plan for 1960 was fulfilled by only 35.6 percent, and the goal for 1965 therefore probably will be fulfilled by about 50 percent. Even this production requires a very high average annual rate of increase and should result in the saving of half a billion rubles and 3 million to 4 million cu m of lumber.

Other plastic products of some importance are pipe and sanitary technical equipment. It is planned to use 62,000 tons of these products in 1965 to replace 600,000 tons of metals. These and other uses of plastics in construction are to consume up to 30 percent of the total volume of output of plastics in 1965. <sup>41/</sup> Although production (and therefore consumption) will be considerably below the planned levels, the total production of plastics probably will lag considerably, so that their use in construction may approach that percentage in 1965.

The two principal waste wood products are wood fiber and wood shavings slabs (or sheets). The former product will have the highest rate of increase in production of any construction material during 1961-65 and is classified as an insulating material. The principal uses probably are for interior walls and partitions. Wood shavings board is used in place of plywood and other lumber products. It is only two-thirds as expensive as plywood, and 1 cu m replaces 1.47 cu m of lumber. The use of these products should result in considerable savings of lumber and plywood. <sup>42/</sup>

The most important insulation material is mineral wool. Although its production increased rapidly during 1956-60 and probably will continue to increase, at a slightly higher average annual rate, production has not been sufficient to fulfill the demand for it. During 1957 and 1958, little more than half of the demand was satisfied, <sup>43/</sup> and, in spite of the large increases in production, the demand for this material will continue to be badly underfulfilled through 1965.

APPENDIX A

STATISTICAL TABLES



Table 5  
Price per Unit, Production, and Value of Construction Materials in the USSR a/  
1950, 1955-60, and 1965

	Material	Unit of Measure of Production	Price per Single Unit b/ (1 July 1955 Rubles)	1950		1955		1956		1957		1958		1959		1960		1965 Estimate	
				Production	Value (Million 1 July 1955 Rubles)	Production	Value (Million 1 July 1955 Rubles)	Production	Value (Million 1 July 1955 Rubles)	Production	Value (Million 1 July 1955 Rubles)	Production	Value (Million 1 July 1955 Rubles)	Production	Value (Million 1 July 1955 Rubles)	Production	Value (Million 1 July 1955 Rubles)	Production	Value (Million 1 July 1955 Rubles)
Cement	Thousand metric tons	g/	10,194	1,090	22,404	2,940	24,898	2,780	26,896	31,308	3,860	38,781	4,540	45,580	5,370	81,000	9,960		
Precast concrete g/	Million cubic meters	427	1.3	555	5.3	2,230	8.8	3,670	13.8	5,730	19.5	7,880	25.4	9,740	38.3	12,000	52	17,500	
Of which:																			
Prestressed concrete g/	Thousand cubic meters	572	Regl.	Regl.	75	43	203	116	341	195	1,050	601	2,674	1,530	4,092	2,340	11,000 g/	6,490	
Wall materials	Billions standard bricks		13.0	3,120	25.6	6,100	26.7	6,440	31.4	7,670	37.2	9,140	42.0	10,300	44.6	10,900	66	18,800	
Of which:																			
Construction brick	Billions standard bricks	0.231	10.2	2,850	20.8	4,800	21.6	4,990	24.7	5,710	28.7	6,630	31.0	7,620	35.5	8,200	44	10,200	
Dimension and field stone	Billions standard bricks	0.232	1.3	302	2.4 g/	557	2.4	557	2.8	650	3.9	905	4.4	1,020	4.7	1,050	8	1,860	
Large concrete (including porous) and silicate wall blocks	Billions standard bricks	0.490	0	0	0	0	0.3	147	0.6	294	1.0	490	1.1	539	1.4	606	10	4,900	
Other wall materials g/	Billions standard bricks	0.310	1.5	465	2.4	744	2.4	744	3.3	1,080	3.6	1,180	3.5	1,080	3.0	930	4	1,240	
Rock products	Million cubic meters	15.5	62	961	166	2,370	130	2,940	204	3,160	283	3,460	250	3,880	280 g/	4,340	425 g/	6,590	
Construction steel b/	Thousand metric tons	5,340	3,370	9,380	6,990	9,170	6,830	10,100	7,060	10,700	7,420	11,800	8,360	12,600	9,980	20,600	15,400	15,400	
Construction lumber b/	Million cubic meters	22	1.5 g/	33	6	132	7	154	8	176	11.2	246	12.0 g/	264	13	286	50	1,100	
Limestone	Million square meters	6.6	76.9	508	99.8	659	112.2	741	120.9	798	133.1	878	139.8	963	147.2	972	228 g/	1,480	
Polished glass	Thousand square meters	66.4	853	17	1,502	120	1,730	119	2,000 g/	133	2,200	142	2,560	197	3,285	254	8,300 g/	551	
Construction lime	Thousand metric tons	86	4,154	337	6,205	534	6,388	549	7,208	680	8,385	721	9,258	796	9,562	822	16,000	1,390	
Gypsum	Thousand metric tons	88	1,732	151	2,870	253	3,000	264	3,504	308	4,005	332	4,461	399	4,682	407	9,500	836	
Dry gypsum plaster board	Thousand square meters	3.64	4.7	17	41.1	150	46.6	170	59.0	215	67	244	89 g/	309	106	396	154 g/	561	
Flooring and facing tile	Thousand square meters	20.9	2.2	46	8.4	176	10.5	219	12.7	265	14.5	303	15.2	318	18.5 g/	387	36.5	763	
Roofing tile	Thousand pieces	0.538	220.5	120	472.1	254	498.4	269	557.2	300	671.0	361	761.4	410	824 g/	443	1,500	827	
Flat roofing	Thousand square meters	1.080	205.5	293	503.7	512	536.0	551	581.0	597	640.1	666	689.8	709	750.1	771	1,310 g/	1,350	
Asbestos cement shingle	Million standard units	0.396	546.4	211	1,488.0	574	1,809.4	620	2,132.9	631	2,406.7	689	2,603.4	1,000	2,991.4	1,160	6,000 g/	2,380	
Asbestos cement pipe	Standard kilometers	12,800	3,500	43	12,148	148	13,200	161	14,000	171	15,200	185	17,000 g/	207	18,600	227	40,000 g/	428	
Iron sewer pipe and fittings	Thousand metric tons	1,120	79.9	94	134.9	127	150.5	178	170.4	201	196.1	231	228.0	269	294.9	324	330	389	
Ceramic sewer pipe	Thousand metric tons	740	27.9	21	24.0	158	238.2	176	273.8	203	296.9	217	317.7	235	349.6	259	750	555	
Sanitary technical equipment																			
Heating boilers	Thousand square meters	158	349	55	91.5	145	1,027	167	1,237	195	1,316	208	1,414	223	1,548	245	2,400 g/	379	
Heating radiators	Thousand square meters	39.1	4.8	188	7.8	305	8.5	338	9.5	371	11.3	442	13.6	532	16.7	693	28.3 g/	1,110	
Enamelled iron bathtubs	Thousand units	245	20	321	80	375	93	428	106	516	128	608	151	715	177	1,520 g/	377	395	
Bath water heaters	Thousand units	305	24	16	195	60	247	75	331	101	393	120	516	157	621	187	1,000 g/	377	
Mineral wool insulation	Thousand cubic meters	69	0.7	46	1.6	104	1.9	124	2.3	150	2.6	169	3.3	214	4.0	260	10.6 g/	689	
Wood fiber slabs	Thousand square meters	6	6.2	37	16.5	99	21.3	128	29.2	175	34.9	209	52.1	313	67.6	406	300 g/	1,200	
Refractories																			
Fire clay	Thousand metric tons	146	2,631	304	3,878	566	4,024	598	4,302	613	4,365	637	4,638	677	4,922	719	11,400 g/	1,940 g/	
Dinax	Thousand metric tons	124	734	94	728	90	655	91	623	77	620	77	654	81	665	82	1,500 g/	82	
Magnetite and chrome magnetite brick	Thousand metric tons	379	233	88	608	230	748	293	785	298	835	316	908	363	1,050	398	1,500 g/	1,940 g/	
Magnetite powder (metallurgical)	Thousand metric tons	123	313	38	667	82	737	93	934	115	913	112	952	117	1,062	131	1,500 g/	377	
Total gross value of production b/				22,400		40,800		51,200		59,100		68,400		77,200		85,200		116,000	
Less duplication b/				475		1,290		1,730		2,430		3,170		3,890		4,740		8,580	
Total value added in production b/ g/				21,925		39,510		49,470		56,670		65,230		73,310		80,460		107,420	

a. Most of the production data through 1960 are from source b/. Some data were obtained from other published Soviet material. Where production data for 1960 were not available, plan data were used. Except when reported data are used, production data are rounded to three significant digits. All value data are rounded to three significant digits or less. Because of rounding, components may not add to the totals shown.  
b. All prices except those for precast and prestressed concrete, rock products, steel, and limestone were obtained from source b/. These prices generally do not include transportation from the producer to the consumer.  
c. Cement is priced by type and by grade for five different price zones. The distribution of production of cement by regions and republics was used to determine as closely as possible the percent of the total that was produced in each of the five price zones. The percent for each zone was multiplied by the price of the average grade (weighted by type) for each year, and the results were totaled. To get the undelivered price, the prices of zone 1 were decreased by 15 rubles and the prices in the other zones by 20 rubles each. These prices are therefore weighted by price zone and by type, and each should be a true average price for the average grade of cement produced in the USSR. It was necessary, however, to assume that the national average grade was produced in each price zone and also that the national complex of types was produced in each zone. The increase in price from 107 rubles per ton in 1950 to 123 rubles in 1965 is due primarily to the rising quality of cement.  
d. The quantity data for precast concrete include prestressed concrete. The value data for precast concrete exclude the value of prestressed concrete.  
e. (Same).  
f. Estimated.  
g. Production data in this category are residuals left after deducting construction brick, dimension and field stone, and large concrete and silicate wall blocks from total wall materials. For pricing purposes, this residual is assumed to consist of small solid wall blocks of slag concrete.  
h. For an explanation of prices and production data, see the methodology, Appendix B.  
i. In 1959 and 1960, production was given in square meters, and in 1959 production in units also was given. The ratio in 1959 was applied to the total number of square meters in 1960 to obtain the total in units.  
j. Assumed to be 1.7 times the price of 1959.  
k. Based on the weighted average price of 170 rubles per ton in 1959.  
l. See the methodology, Appendix B.  
m. For an explanation of the term value added as used in this report with reference to the construction materials industry, see the methodology, Appendix B.

Table 6

Capital Expenditures Required to Increase Production Capacity  
for Nine Construction Materials in the USSR a/  
1959-65

		Current Rubles per Unit of Capacity <u>b/</u>		
Material	Unit of Measure	Construction of New Plants	Expansion of Existing Plants	Modernization and Intensification of Production
Cement	Metric tons	280	210	100 to 120
Precast reinforced concrete components	Cubic meters	425	275 to 300	150
Rock products	Cubic meters	55	30 to 35	25
Asbestos cement shingle	Thousand standard units	455		360
Asbestos cement pipe	Standard kilometers	22,800		13,700
Lime	Metric tons	200	150	75 to 125
Construction gypsum	Metric tons	105	75	30 to 50
Dry gypsum plaster board	Thousand square meters	1,185		800
Window glass	Square meters (2 mm thick)	890		720

a. 47/. Capital investments are calculated as averages for 1959-65 for each material, taking into account the share of enterprises of the various types and capacities. The first two categories are primarily determined according to project data, and the third category is determined on the basis of actual data on fulfillment during 1955-60.

b. Ruble values in use before the Soviet currency reform of 1961.

Table 7  
Number of Plants Producing Selected Construction Materials  
in the USSR a/

Material	Year	Number of Plants
Cement	Mid-1962	86 <u>b/</u>
Precast concrete	Mid-1962	2,500
Rock products (extraction and processing)	End of 1961	Almost 4,000
Brick	Late 1959	Above 6,500
Asbestos cement articles	End of 1960	30
Flat glass	Early 1961	24
Soft roofing	1958	57
Slag concrete blocks	1957	480
Gypsum <u>c/</u>	End of 1958	85
Mineral wool insulation <u>d/</u>	Mid-1959	34
Estimated total number of plants <u>e/</u>	End of 1961	15,500

a. The numbers of plants are all given in or derived from published Soviet sources. There is some duplication because some of these plants produce more than one material. However, some minor installations whose output is not included in national output statistics are excluded from this table.

b. Including six plants that are grinding installations only.

c. RSFSR only.

d. Plants and shops.

e. This estimate includes quarries but not steel or lumber plants.

## APPENDIX B

METHODOLOGY

This appendix is concerned with the derivation of the calculated index of the gross value of construction materials in the USSR and the derivation of the calculated index of the value added in production as well as with the method of determining the quantity and value of steel and lumber in construction. The product of this methodology is contained in Table 5.\* The method of determining the preliminary figures for 1961 also is explained. In addition, further details on comparisons of construction materials indexes are given.

To obtain the index of the gross value of production of construction materials, production of each of the materials for every year and a price in 1 July 1955 rubles were obtained. The sum of the products of the quantity and price for each commodity for each year yielded the total value of production. The index was constructed from the annual totals. To obtain the value-added index, the value of four commodities (cement, gypsum, rock products, and steel) that are utilized in other construction materials was removed from each annual total, thus adjusting for the double counting of products. The input of each of these commodities was determined per unit of finished product and was multiplied by the average price of the input commodity (for inputs of cement and gypsum). However, the rock products and steel inputs were priced according to the type of each commodity being used in a product -- for example, in a cubic meter of precast concrete, calculations indicated that there was one-fourth of a cubic meter each of gravel and crushed stone and one-third of a cubic meter of sand. The average price of the inputs was determined on the basis of the weighted price of each of these rock products. The average weight of steel reinforcement in both precast and prestressed concrete was determined and was priced according to the special types of steel used in each product. The total value of the four commodities used in other construction materials was deducted from the gross value of production in each year to obtain the value added in production, and an index was constructed from the annual results.

The quantity of lumber in construction was determined on the basis of total lumber produced and of production of railroad ties converted into cubic meters. Although not all of the lumber produced is used in construction, the value of the round timber used in construction is offset by the value of the nonconstruction uses of lumber, and the trends in the values of the two were judged to be similar. The regional

\* Appendix A, p. 27, above.

production of lumber and ties in 1955 was determined and then was priced, by region, to obtain the average weighted price for both commodities. The average transportation charges were available and were deducted from the average prices.

The total amount of steel used in construction (excluding rails and pipe) was given for 1955 and was derived for 3 other years. The derivations were based on the input of a given tonnage per million rubles of construction-installation work (the total value of construction-installation work in each year was known). It was found that the quantities obtained accounted for almost identical percentages -- that is, from 15.3 to 15.9 percent of all the finished steel produced -- so that the use of steel in construction (excluding rails and pipe) was estimated for the other years on the basis of 15.6 percent of the total rolled steel. The annual use of rails in construction was assumed to be the same as the annual production (production for 1965 was estimated). Trunk oil and gas pipeline for each year was converted from kilometers to tons. Local gas and oil pipeline was estimated for all years on the basis of the ratio between local and mainline pipe given by a Soviet source for 1959-65. The ratio between the calculated figure for trunk and local pipeline in 1965 and a figure for the use of all pipe in construction in 1965 was applied to all previous calculations to allow for the other uses of steel pipe in construction. The tonnage for construction steel, rails, and pipe for each year was totaled to obtain steel used in construction.

The total value of all construction steel was determined on the basis of type. Structural steel used in construction was derived for 2 years, and the plan was given for 1965. The use in the past 2 years was almost identical, and it was assumed that the quantities used in other years were almost the same. The steel used in prestressed concrete was obtained from a source that gave the per-unit usage, which was multiplied by production of prestressed concrete in each year. The expected use of regular reinforcing steel was given for 1965. When this figure was added to structural steel and to steel for prestressed concrete and then compared with the total steel usage in construction in 1965, a residual of 9.8 percent resulted, which was assumed to be the percentage that miscellaneous steel was of the total during all years. Regular reinforcing steel was then derived for other years as the residual between total construction steel (excluding rails and pipe) and structural, prestressing, and miscellaneous steel. The price of each of the types of steel was estimated, using price books, and the quantity of each type of steel was multiplied by its average price to obtain the total value of the steel used in construction in each year.

Preliminary 1961 figures for the increases in the gross and value-added indexes of production of construction materials were based on an

available sample of commodities,\* 48/ accounting for 42.5 percent of the gross value and 45.4 percent of the value added in 1960. The value of these commodities, however, in relation to both totals has been increasing each year since 1955, so that it was estimated that these commodities accounted for 44.5 percent of the gross value and 48.0 percent of the value added in 1961. On the basis of these assumptions the total value for each category was calculated, and the indexes were computed.

The principal differences between the computed value-added index of production of construction materials in the USSR (hereafter called the USSR index) and the value-added index for the US, calculated by the Federal Reserve Board (hereafter called the FRB index), were noted in I, B.\*\* The specific exclusions from each index, however, were not enumerated and are noteworthy. The USSR index includes a more complete coverage of wall materials (the FRB index includes only brick) and sanitary technical equipment and includes linoleum (not all of which is used in construction), refractories, and insulation, which are omitted in the FRB index. Conversely, the FRB index includes a more complete coverage of hardware and metal fixtures, vitreous and porcelain fixtures, and abrasives and a better coverage of asphalt products, lumber and wood products (including plywood), and paints. Plywood and paints have been excluded in the USSR index because the major portions of these products in the USSR are consumed in other than construction uses, whereas in the US the major portions of these products are used in construction, so that their inclusion in the US is valid while these commodities in the USSR are better excluded.

In addition to the FRB index, the US Department of Commerce calculates an index for the US, 49/ but this is a gross value index using 1947-49 prices. The FRB index increases at a more rapid rate and has 25 to 30 percent greater coverage, by value, of construction materials produced in the US than does the Department of Commerce index. The Department of Commerce index is limited in the number of commodities covered because it requires monthly reports on a material to include it in the index, while the FRB includes all materials for which there is annual data. The FRB index is more comparable to the USSR index because it has more complete coverage, is a value-added index and probably has a more comparable price base.

There also is another index of construction materials in the USSR calculated in a project published by the Rand Corporation. 50/ This

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\* The seven commodities for which preliminary production figures have been published are cement, precast concrete, construction brick, large wall blocks, window glass, asbestos cement shingles, and soft roofing.

\*\* P. 5, above.

index increases at a lower rate than the USSR index (covering a period from 1927/28 to 1958) and differs from the latter index as follows:

1. The Rand index, as the title denotes, is a materials input index of Soviet construction and therefore attempts to measure the apparent consumption of materials in construction and not production of construction materials.

2. The latest price base used in the Rand index is in July-December 1950 prices. These prices are higher in general than the 1 July 1955 prices used in the USSR index and are not recent enough to allow realistic pricing of the newer items in construction materials, which are increasing at a rapid rate.

3. As the Rand index was calculated at an earlier date, it lacks reliable data for the later years that were not available at the time of publication. The index was forced to rely on projections of production and relationships that existed during the 1930's. Subsequent data have indicated that much of the estimating was inaccurate -- as, for example, in the case of rails and rock products.

4. The USSR index is based on a broader sample of materials -- as, for example, in 1958, when more than 20 percent of the value of materials included in the USSR index is not included in the Rand index (the Rand index does include paints). This determination is consistent with the Rand estimate that the index includes only 60 to 70 percent of the value of all construction materials, whereas it is estimated that the USSR index includes somewhat more than 90 percent. The items omitted in the Rand index, in general, are ones in which production has been increasing at above-average rates and include precast and prestressed concrete, a number of masonry wall materials, refractories, mineral wool insulation, linoleum, wood fiber slabs, polished glass, gypsum wall board, ceramic pipe, and wall tile. The omission of these items is the primary reason for the lower rate of increase in the Rand index than in the USSR index.

5. A small number of the materials in the USSR index include the cost of transportation,\* whereas the Rand index attempts to exclude all transportation charges.

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\* See I, B, p. 5, above.

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